

## § 173.229

(3) The use of a pressure relief device is not authorized.

(b) A material in Hazard Zone A must be transported in a seamless specification cylinder conforming to the requirements of §173.40. However, a welded cylinder filled before October 1, 2002, in accordance with the requirements of this subchapter in effect at the time of filling, may be transported for reprocessing or disposal of the cylinder's contents until December 31, 2003. No cylinder may be equipped with a pressure relief device.

[67 FR 51643, Aug. 8, 2002, as amended at 67 FR 61289, Sept. 30, 2002; 68 FR 24660, May 8, 2003, as amended at 71 FR 33881, June 12, 2006]

## § 173.229 Chloric acid solution or chlorine dioxide hydrate, frozen.

When the §172.101 table specifies that a hazardous material be packaged in accordance with this section, only 4G fiberboard boxes, with inner packagings of polyethylene or other suitable material, are authorized. Fiberboard boxes must be reinforced and insulated and sufficient dry ice must be used to maintain the hydrate or acid in a frozen state during transportation. Each packaging must conform to the general packaging requirements of subpart B of part 173, and to the requirements of part 178 of this subchapter at the Packing Group I performance level. Transportation is authorized only by private or contract carrier by motor vehicle.

## § 173.230 Fuel cell cartridges containing hazardous material.

(a) *Requirements for Fuel Cell Cartridges.* Fuel cell cartridges, including when contained in or packed with equipment, must be designed and constructed to prevent fuel leakage under normal conditions of transportation. Fuel cell cartridge design types using liquids as fuels must pass an internal pressure test at a gauge pressure of 100 kPa (15 psig) without leakage. Except for fuel cell cartridges containing hydrogen in metal hydride which must be in conformance with paragraph (d) of this section, each fuel cell cartridge design type including when contained in or packed with equipment, must pass a 1.2 meter (3.9 feet) drop test onto an unyielding surface in the orientation

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most likely to result in the failure of the containment system with no loss of contents. Fuel cell cartridges installed in or integral to a fuel cell system are regarded as contained in equipment. Fuel cell cartridges containing a Division 2.1, Division 4.3 or Class 8 material must meet the following additional requirements.

(b) A fuel cell cartridge designed to contain a Division 4.3 or a Class 8 material may contain an activator provided it is fitted with two independent means of preventing unintended mixing with the fuel during transport.

(c) Each fuel cell cartridge designed to contain a liquefied flammable gas must:

(1) Be capable of withstanding, without leakage or bursting, a pressure of at least two times the equilibrium pressure of the contents at 55 °C (131 °F);

(2) Contain no more than 200 mL of liquefied flammable gas with a vapor pressure not exceeding 1,000 kPa (150 psig) at 55 °C (131 °F); and

(3) Pass the hot water bath test prescribed in accordance with §173.306(a)(3)(v).

(d) Each fuel cell cartridge designed to contain hydrogen in a metal hydride must conform to the following:

(1) Each fuel cell cartridge must have a water capacity less than or equal to 120 mL (4 fluid ounces).

(2) Each fuel cell cartridge must be a design type that has been subjected, without leakage or bursting, a pressure of at least two times the design pressure of the cartridge at 55 °C (131 °F) or 200 kPa (30 psig) more than the design pressure of the cartridge at 55 °C (131 °F), whichever is greater. The pressure at which the test is conducted is referred to as the "minimum shell burst pressure." The pressure within the fuel cell cartridge must not exceed 5 MPa (725 psig) at 55 °C (131 °F).

(3) Each fuel cell cartridge must be filled in accordance with the procedure provided by the manufacturer. The manufacturer must provide the following information with each fuel cell cartridge:

(i) Inspection procedures to be carried out before initial filling and before refilling of the fuel cell cartridge;

(ii) Safety precautions and potential hazards to be aware of;

(iii) A method of determining when the rated capacity has been achieved;

(iv) Minimum and maximum pressure range;

(v) Minimum and maximum temperature range; and

(vi) Any other requirements to be met for initial filling and refilling including the type of equipment to be used.

(4) Each fuel cell cartridge must be permanently marked with the following information:

(i) The rated charging pressure in megapascals (MPa);

(ii) The manufacturer's serial number of the fuel cell cartridges or unique identification number; and

(iii) The expiration date based on the maximum service life (yyyy/mm).

(5) *Design type tests:* Each fuel cell cartridge design type must be subjected to and pass the following tests (this includes cartridges integral to a fuel cell):

(i) *Drop test.* A 1.8 m (5.9 feet) drop test onto an unyielding surface must be performed. There must be no leakage. Leakage must be determined using a soap bubble solution or other equivalent means on all possible leak locations, when the fuel cell cartridge is charged to its rated charging pressure. The fuel cell cartridge must then be hydrostatically pressurized to destruction. The burst pressure must be greater than 85% of the minimum shell burst pressure. The drop must be performed in the following four different orientations:

(A) Vertically, on the end containing the shut-off valve assembly;

(B) Vertically, on the end opposite to the shut-off valve assembly;

(C) Horizontally, onto a steel apex with a diameter of 3.8 cm (9.7 in), with the steel apex in the upward position; and

(D) At a 45° angle on the end containing the shut-off valve assembly.

(ii) *Fire test.* A fuel cell cartridge filled to rated capacity (with hydrogen) must be subjected to a fire engulfment test. The cartridge design (including design types with an integral vent feature) is deemed to pass the fire test if:

(A) The internal pressure vents to zero gauge pressure without the rupture of the cartridge; or

(B) The cartridge withstands the fire for a minimum of 20 minutes without rupture.

(iii) *Hydrogen cycling test.* A fuel cell cartridge must be subjected to a hydrogen cycling test to ensure that the design stress limits are not exceeded during use. The fuel cell cartridge must be cycled from not more than 5% rated hydrogen capacity to not less than 95% rated hydrogen capacity and back to not more than 5% rated hydrogen capacity. The rated charging pressure must be used for charging and temperatures must be within the operating temperature range. The cycling must be continued for at least 100 cycles. Following the cycling test the fuel cell cartridge must be charged and the water volume displaced by the cartridge must be measured. The cartridge design is deemed to pass the test if the water volume displaced by the cycled cartridge does not exceed the water volume displaced by an uncycled cartridge charged to 95% rated capacity and pressurized to 75% of its minimum shell burst pressure.

(6) *Production leak test.* Each fuel cell cartridge must be tested for leaks at  $15^{\circ}\text{C} \pm 5^{\circ}\text{C}$  ( $59^{\circ}\text{F} \pm 9^{\circ}\text{F}$ ) while pressurized to its rated charging pressure. There must be no leakage. Leakage must be determined using a soap bubble solution or other equivalent means on all possible leak locations.

(e) The following packagings are authorized provided the general packaging requirements subpart B of part 173 of this subchapter are met:

(1) For fuel cell cartridges, rigid packagings conforming to the requirements of part 178 of this subchapter at the packing group II performance level; and

(2) Strong outer packagings for fuel cell cartridges contained in equipment or packed with equipment. Large equipment containing fuel cell cartridges may be transported unpackaged if the equipment provides an equivalent level of protection.

(i) Fuel cell cartridges packed with equipment must be packed with cushioning material or divider(s) or inner

packagings so that the fuel cell cartridges are protected against damage that may be caused by the shifting or placement of the equipment and cartridges within the packaging.

(ii) Fuel cell cartridges contained in equipment must be protected against short circuits and the entire fuel cell system must be protected from unintentional activation. The equipment must be securely cushioned in the outer packaging.

(f) For transportation by aircraft, the following additional provisions apply:

(1) The package must comply with the applicable provisions of §173.27 of this subchapter;

(2) For fuel cell cartridges contained in equipment, fuel cell systems must not charge batteries during transport;

(3) For transportation aboard passenger aircraft, for fuel cell cartridges contained in equipment, each fuel cell system and fuel cell cartridge must conform to IEC PAS 62282–6–1 Ed. 1 (IBR, *see* §171.7 of this subchapter) or a standard approved by the Associate Administrator;

(4) When packed with equipment, fuel cell cartridges must be packed in an intermediate packaging along with the equipment they are capable of powering, and the intermediate packagings packed in a strong outer packaging. The maximum number of fuel cell cartridges in the intermediate packaging may not be more than the number required to power the equipment, plus two spares;

(5) Large robust articles containing fuel cells may be transported unpackaged when approved by the Associate Administrator; and

(6) The mass of a fuel cell cartridge containing a Division 4.3 or Class 8 materials must be not more than 1 kg (2.2 lbs).

(7) Fuel cell cartridges intended for transportation in carry-on baggage on board passenger aircraft must comply with paragraphs (a), (b), (c), (d) in this section and the applicable provisions prescribed in §175.10 of this subchapter.

(g) *Limited quantities.* Limited quantities of hazardous materials contained in fuel cell cartridges are excepted from the labeling requirements, unless the cartridges are offered for transportation or transported by aircraft, and

from the placarding and specification packaging requirements of this subchapter when packaged according to this section. Each package must conform to the packaging requirements of subpart B of this part and may not exceed 30 kg (66 pounds) gross weight. Except as authorized in paragraph (h) of this section, a package containing a limited quantity of fuel cell cartridges must be marked as specified in §172.315 of this subchapter and, for transportation by highway or rail, is not subject to the shipping paper requirements of subpart C of part 172 of this subchapter, unless the material meets the definition of a hazardous substance, hazardous waste, or marine pollutant, and are eligible for the exceptions provided in §173.156 of part. For transportation by highway, rail and vessel, the following combination packagings are authorized:

(1) For flammable liquids, in fuel cell cartridges containing not more than 1.0 L (0.3 gallon) per cartridge, packed in strong outer packaging.

(2) For water-reactive substances (Division 4.3 Dangerous when wet material), in fuel cell cartridges containing not more than 0.5 L (16.9 fluid ounces) for liquids or not over 0.5 kg (1.1 pound) for solids per cartridge, packed in strong outer packaging.

(3) For corrosive materials, in fuel cell cartridges containing not more than 1.0 L (0.3 gallon) for liquids or not more than 1.0 kg (2.2 pounds) for solids per cartridge, packed in strong outer packaging.

(4) For liquefied (compressed) flammable gas, in fuel cell cartridges not over 120 mL (4 fluid ounces) net capacity per cartridge, packed in strong outer packaging.

(5) For hydrogen in metal hydride, in fuel cell cartridges not over 120 mL (4 fluid ounces) net capacity per cartridge, packed in strong outer packaging.

(6) For transportation by aircraft, the following combination packagings are authorized:

(i) For flammable liquids, in fuel cell cartridges containing not more than 0.5 L (16.9 fluid ounces) per cartridge, packed in strong outer packaging. Additionally, each package may contain

no more than 2.5 kg (net mass) of fuel cell cartridges.

(ii) For water-reactive substances (Division 4.3 Dangerous when wet material), in fuel cell cartridges containing not more than 200 g (0.4 pounds) of solid fuel per cartridge, packed in strong outer packaging. Additionally, each package may contain no more than 2.5 kg (net mass) of fuel cell cartridges.

(iii) For corrosive materials, in fuel cell cartridges containing not more than 200 mL (6.7 fluid ounces) for liquids or not more than 200 g (0.4 pounds) for solids per cartridge packed in strong outer packaging. Additionally, each package may contain no more than 2.5 kg (net mass) of fuel cell cartridges.

(iv) For liquefied (compressed) flammable gas, in fuel cell cartridges not over 120 mL (4 fluid ounces) net capacity per cartridge, packed in strong outer packaging. Additionally, each package may contain no more than 0.5 kg (net mass) of fuel cell cartridges.

(v) For hydrogen in metal hydride, in fuel cell cartridges not over 120 mL (4 fluid ounces) net capacity per cartridge, packed in strong outer packaging. Additionally, each package may contain no more than 0.5 kg (net mass) of fuel cell cartridges.

(h) *Consumer commodities.* Until December 31, 2013, except for transportation by aircraft, a limited quantity that conforms to the provisions of paragraph (g) of this section and is also a “consumer commodity” as defined in § 171.8 of this subchapter on October 1, 2010 may be renamed “Consumer commodity” and reclassified as ORM-D. Shipments of ORM-D materials are not subject to the shipping paper requirements of subpart C of part 172 of this subchapter, unless the material meets the definition of a hazardous substance, hazardous waste, marine pollutant, and are eligible for the exceptions provided in § 173.156 of this part.

[74 FR 2263, Jan. 14, 2009, as amended at 75 FR 73, Jan. 4, 2010; 76 FR 3379, Jan. 19, 2011]

## Subpart F—Bulk Packaging for Hazardous Materials Other Than Class 1 and Class 7

### § 173.240 Bulk packaging for certain low hazard solid materials.

When § 172.101 of this subchapter specifies that a hazardous material be packaged under this section, only the following bulk packagings are authorized, subject to the requirements of subparts A and B of part 173 of this subchapter and the special provisions specified in column 7 of the § 172.101 table.

(a) *Rail cars:* Class DOT 103, 104, 105, 109, 111, 112, 114, 115, or 120 tank car tanks; Class 106 or 110 multi-unit tank car tanks; and metal non-DOT specification, sift-proof tank car tanks and sift-proof closed cars.

(b) *Motor vehicles:* Specification MC 300, MC 301, MC 302, MC 303, MC 304, MC 305, MC 306, MC 307, MC 310, MC 311, MC 312, MC 330, MC 331, DOT 406, DOT 407, and DOT 412 cargo tank motor vehicles; non-DOT specification, sift-proof cargo tank motor vehicles; and sift-proof closed vehicles.

(c) *Portable tanks and closed bulk bins.* DOT 51, 56, 57 and 60 portable tanks; IMO type 1, 2 and 5, and IM 101 and IM 102 portable tanks; UN portable tanks; marine portable tanks conforming to 46 CFR part 64; and sift-proof non-DOT Specification portable tanks and closed bulk bins are authorized.

(d) *IBCs.* IBCs are authorized subject to the conditions and limitations of this section provided the IBC type is authorized according to the IBC packaging code specified for the specific hazardous material in Column (7) of the § 172.101 Table of this subchapter and the IBC conforms to the requirements in subpart O of part 178 of this subchapter at the Packing Group performance level as specified in Column (5) of the § 172.101 Table of this subchapter for the material being transported.

(1) IBCs may not be used for the following hazardous materials:

(i) Packing Group I liquids; and

(ii) Packing Group I solids that may become liquid during transportation.

(2) The following IBCs may not be used for Packing Group II and III solids that may become liquid during transportation: